HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: Iss2061-N1
WELL NAME/DEPTH: Esso Gulf et al. Issungnak
2-O-61-70-10-134-00/2376.85 m

INDURATION: very poor, either dry or immersed in water.
COLOUR: light brown
SEDIMENTARY STRUCTURES: massive

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 59

%gravel size: 0

%sand size: 51

%silt size: 5

%clay size: 3

Cement %: 5% pore-lining kaolinite cement, 1% quartz overgrowths on monocrystalline quartz and chert grains.

Porosity %: 35. A porosity of 32.7% and a permeability of 13,260 millidarcies was determined for core plug 8 taken near this sample.

Modal Size: 0.3 mm.

Sorting: 16%/84% diameter ratio=
500 micrometres/ 150 micrometres = 3.3

Verbal Sorting Scale: moderately sorted but fine material was undoubtedly removed during diagenesis.

GRAIN SIZE NAME: muddy medium sandstone

COMPOSITION: 15% monocrystalline quartz grains, 10% polycrystalline dquartz grains, 20% chert grains, 15% phylloid and siltstone clasts, 5% alkali feldspar grains.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): Kaolinite-cemented muddy medium grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: Primary porosity was probably reduced during burial to about 15%, judging by the nature of the mechanical and chemical compaction (squeezing of phylloid clasts) and fracturing of competent grains. Subsequently, about 20% (of the total rock volume) was added in the form of secondary porosity. Oversized and elongate pores and grain molds contributed perhaps 15% while intragranular leaching (mainly of phylloid and siltstone clasts) accounts for about 5%.

Other evidence for secondary porosity development includes floating grains, leached lamellae of muscovite flakes, rhomb-shaped carbonate dissolution molds in chert and phylloid clasts, as well as rhomb-shaped partial carbonate dissolution molds at grain boundaries. Elongate pores and carbonate dissolution molds in phylloid clasts are lined with framboidal pyrite, clearly demonstrating its late diagenesis. Kaolinite lines secondary pores and is therefore late diagenetic as well.

The section was not stained with the lime green concentrate because of the high solubility of the epoxy, caused by the addition of toluene in attempt to lower viscosity and increase the solubility of dyes. As a matter of interest, the proportion of grains fractured during sample preparation was higher for those samples in which toluene was added to the epoxy. It may be that the toluene evaporated, leaving less impregnant supporting the grains.

THIN SECTION MODAL AND GRAIN SIZE ANALYSIS

Sample I.D.: Iss2061-N1

	No of Points	Percentage of Components	Percentages of Detrital Components
Detrital Components			
Monocrystalline Quartz	55	18.33	26.19
Polycrystalline Quartz	34	11.33	16.19
Clear Chert	55	18.33	26.19
Black Chert	24	8.00	11.43
Alkali Feldspar	19	6.33	9.05
Plagioclase	0	0.00	0.00
Phylloid Clasts	20	6.67	9.52
Volcanic Clasts	0	0.00	0.00
Chlorite	0	0.00	0.00
Mica	2	0.67	0.95
Siltstone Clasts	1	0.33	0.48
Coal	0	0.00	0.00
Unidentified (too small)	0	0.00	0.00
Other Clasts	0	0.00	0.00
Cements			
Kaolinite	0	0.00	
Carbonate	0	0.00	
Other	0	0.00	
Porosity			
Intergranular/ Moldic	88	29.33	

Intragranular	2	0.67
Plucked Grains	8	

Total number of points counted minus plucked grains= 300

GRAIN SIZE ANALYSIS

Sample I.D.: Iss2061-N1

Class Interval (phi)	No. Freq of Max Apparent Grain Dimension	Percentage Frequency	Cumulative Percentage Frequency
1.0 to 0.5	9	4.5	4.5
1.5 to 1.0	48	24.0	28.5
2.0 to 1.5	73	36.5	65.0
2.5 to 2.0	48	24.0	89.0
3.0 to 2.5	14	7.0	96.0
3.5 to 3.0	5	2.5	98.5
4.0 to 3.5	1	0.5	99.0
4.5 to 4.0	2	1.0	100.0

GRAPHIC GRAIN SIZE CUMULATIVE PERCENTILES IN PHI (MICROMETRE) UNITS OF SELECTED DETRITAL COMPONENTS

Sample I.D.: Iss2061-N1

Percentiles	Phi Values	Micrometres
1	-	-
5	1.01	497
16	1.31	403
25	1.46	363
50	1.80	287 (medium sand size)
75	2.18	221
84	2.37	193

95 2.90 46

$$\text{Graphic Sorting (Inman)} = \frac{\text{Phi(84)} - \text{Phi(16)}}{2} = 0.53$$

Verbal Sorting Scale= moderately sorted.

Total Number of Grains Measured= 200

Note: Less mud-sized material was determined from the thin section grain size analysis than was estimated qualitatively on a sample fracture surface. Similarly, modal analysis ignored Kaolinite and quartz cements which are clearly visible on a sample fracture surface. In addition, more mono/polycrystalline quartz grains and chert clasts were determined from the modal analysis than were estimated qualitatively in thin section.

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: Iss2061-N2
WELL NAME/DEPTH: Esso Gulf et al. Issungnak
2-0-61-70-10-134-00/2378.19 m

INDURATION: poor either dry or in water
COLOUR: overall a light brown
SEDIMENTARY STRUCTURES: massive

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 62

%gravel size: 0

%sand size: 55

%silt size: 5

%clay size: 2?

Cement %: 3% pore-lining kaolinite, 1% quartz overgrowths

Porosity %: 35% (a porosity of 33.3% and a permeability of 11410 millidarcies was determined for core plug 12, taken near this sample).

Modal Size: 0.35 mm.

Sorting: 16%/84% diameter ratio=
550 micrometres/ 150 micrometres = 3.7

Verbal Sorting Scale: moderately sorted

GRAIN SIZE NAME: silty medium sandstone.

COMPOSITION: 20% monocrystalline quartz grains, 10% polycrystalline quartz grains, 25% chert grains, 5% phylloid and siltstone clasts, 2% alkali feldspar grains, 1% muscovite flakes, 1% pyrite framboids, tr microcline, tr coal.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): kaolinite and quartz cemented silty medium grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: Judging by the degree of mechanical compaction (pressure solution contacts and squeezing of ductile grains), primary porosity was probably reduced to about 20 to 25% percent (depending upon the original detrital clay content). After this reduction, which probably occurred at shallow to moderate depth, carbonate cement occluded a great deal of the porosity and replaced detrital clays and grain boundaries. It also infiltrated the phylloid and siltstone clasts. Although no carbonate remains now, the oversized and elongate pores with

rhomb-shaped carbonate dissolution molds at grain boundaries and within grains clearly points to its former presence. About 7% porosity between grains was added when this carbonate cement was dissolved. About 3% of the rock comprises secondary intragranular porosity, mainly in siltstone and phylloid clasts but a few of the alkali feldspar grains are honeycombed. Other evidence of secondary porosity includes molds and floating grains. The pyrite framboids line secondary intergranular pores and also occur in the secondary pores of phylloid clasts. Kaolinite cement also lines secondary pores. The formation of framboidal pyrite and kaolinite was therefore relatively late in the diagenetic sequence.

THIN SECTION MODAL AND GRAIN SIZE ANALYSIS

Sample I.D.: Iss2061-N2

	No of Points	Percentage of Components	Percentages of Detrital Components
Detrital Components			
Monocrystalline Quartz	53	17.67	24.20
Polycrystalline Quartz	31	10.33	14.16
Clear Chert	76	25.33	34.70
Black Chert	32	10.67	14.61
Alkali Feldspar	16	5.33	7.31
Plagioclase	0	0.00	0.00
Phylloid Clasts	10	3.33	4.57
Volcanic Clasts	0	0.00	0.00
Chlorite	0	0.00	0.00
Mica	0	0.00	0.00
Siltstone Clasts	1	0.33	0.46
Coal	0	0.00	0.00
Unidentified (too small)	0	0.00	0.00
Other Clasts	0	0.00	0.00
Cements			
Kaolinite	0	0.00	
Carbonate	0	0.00	
Other	0	0.00	
Porosity			
Intergranular/ Moldic	80	26.67	

Intragranular	1	0.33
Plucked Grains	2	

Total number of points counted minus plucked grains= 300

GRAIN SIZE ANALYSIS

Sample I.D.: Iss2061-N2

Class Interval (phi)	No. Freq of Max Apparent Grain Dimension	Percentage Frequency	Cumulative Percentage Frequency
0.5 to 0.0	5	2.5	2.5
1.0 to 0.5	24	12.0	14.5
1.5 to 1.0	95	47.5	62.0
2.0 to 1.5	49	24.5	86.5
2.5 to 2.0	21	10.5	97.0
3.0 to 2.5	3	1.5	98.5
3.5 to 3.0	2	1.0	99.5
4.0 to 3.5	0	0.0	99.5
4.5 to 4.0	0	0.0	99.5
5.0 to 4.5	1	0.5	100.0

GRAPHIC GRAIN SIZE CUMULATIVE PERCENTILES IN PHI (MICROMETRE) UNITS OF SELECTED DETRITAL COMPONENTS

Sample I.D.: Iss2061-N2

Percentiles	Phi Values	Micrometres
1	-	-
5	0.68	624
16	1.02	493
25	1.13	457
50	1.39	382 (medium sand size)
75	1.73	301

84	1.93	262
95	2.35	196

$$\text{Graphic Sorting (Inman)} = \frac{\text{Phi(84)} - \text{Phi(16)}}{2} = 0.46$$

Verbal Sorting Scale=well sorted

Total Number of Grains Measured=200

Note: The amount of mud-sized material is underestimated in the thin section grain size analysis, when compared with a qualitative estimate from a sample fracture surface. Modal analysis shows much less phylloid and siltstone clasts than was estimated qualitatively and appears to underestimate the amount of porosity. In addition, no Kaolinite or quartz cements, which are easily seen on a sample fracture surface were observed in the thin section modal analysis.

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: Iss2061-N3
WELL NAME/DEPTH: Esso Gulf et al. Issungnak
2-O-61-70-10-134-00/2378.80 m

INDURATION: very poor
COLOUR: light brown at a distance, scattered dark grey grains
SEDIMENTARY STRUCTURES: massive

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 67

%gravel size: 0

%sand size: 60

%silt size: 5

%clay size: 2?

Cement %: 3% pore-lining kaolinite, tr pore-lining pyrite framboids, minor quartz overgrowths.

Porosity %: 30% (a porosity of 32.5% and a permeability of 10,940 millidarcies was measured for core plug 14, taken near the sample).

Modal Size: 0.20 mm.

Sorting: 16%/84% diameter ratio=
300 micrometres/ 80 micrometres = 3.75

Verbal Sorting Scale: moderately sorted

GRAIN SIZE NAME: silty fine sandstone

COMPOSITION: 20% monocrystalline quartz grains, 5% polycrystalline quartz grains, 20% chert grains, 15% phylloid and siltstone clasts, 3% alkali feldspar, 1% muscovite flakes, tr translucent red-brown resin(?), tr plagioclase, sphene(?), volcanic rock fragments, tr clasts of microspar-sized carbonate, tr chlorite grains, tr coal clasts.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): Kaolinite-cemented silty fine litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: The most important diagenetic event was the production of secondary porosity (10-15% of the rock), mainly as intergranular oversized and elongate pores with corroded grain boundaries, but also as molds and intragranular porosity. In places, quartz overgrowths have been corroded, forming the boundaries of elongate pores. This implies a relatively early pre-carbonate cement origin for at least some

of the quartz overgrowths. Grain molds, many of which are defined by remaining clay rims, comprise about 5% of the rock volume. The evidence for a former carbonate cement as rhomb-shaped carbonate dissolution molds in polycrystalline quartz and clear chert as well as partial rhombic molds at grain boundaries is overwhelming. The degree of mechanical and chemical compaction is moderate, suggesting that the carbonate cementation was relatively early at relatively shallow burial depths. By contrast, Kaolinite cement lines secondary pores as well as the fractures of compactionally broken grains and is therefore relatively late diagenetic. Other diagenetic features include the alteration of some muscovite flakes to chlorite, muscovite (in schist) to carbonate, trace amounts of carbonate replacing chert and framboidal pyrite (lining pores of secondary origin).

Many of the grains were also broken during sample preparation. It is believed that the experimental addition of the fluorescent lime green concentrate (which contains toluene) lowered the strength of the epoxy. When the epoxy was later also stained with the lime green staining solution, about 10 micrometres of the epoxy was removed, re-exposing the pore lining Kaolinite cement (not to be confused with unremoved aluminum oxide polishing powder).

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: Iss2061-N4
WELL NAME/DEPTH: Esso Gulf et al. Issungnak
2-O-61-70-10-134-00/2388.24 m

INDURATION: very poor when dry, disaggregates immediately when immersed in water.
COLOUR: overall a medium brown.
SEDIMENTARY STRUCTURES: planar lamination/bedding is defined by concentrations of discontinuous carbonaceous films, flakes and grains in combination with a higher mud content.

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 69

%gravel size: 0

%sand size: 61

%silt size: 5

%clay size: 2?

Cement %: 1% quartz overgrowths, 1% pore-lining framboidal pyrite, 3% kaolinite (trace large vermicular pore-filling kaolinite), 2% siderite.

Porosity %: 25% (a porosity of 30.4% and a permeability of 348 millidarcies was obtained for core plug 35 near the sample.

Modal Size: 0.15 mm.

Sorting: 16%/84% diameter ratio=
250 micrometres/ 80 micrometres = 3.1

Verbal Sorting Scale: moderately sorted

GRAIN SIZE NAME: silty fine sandstone

COMPOSITION: 20% monocrystalline quartz, 3% polycrystalline quartz, 15% chert, 20% phylloid and siltstone clasts (especially chlorite-rich clasts), 2% alkali feldspar, 2% chlorite grains, 3% carbonaceous flakes/grains, 5% muscovite flakes (partly altered to chlorite and/or carbonate, tr glauconite(?) pellets (altered to chlorite), trace of volcanic rock fragments, trace plagioclase, trace microcline, sphene(?).

ROCK NAME (cements, miscellaneous transported constituents, clan designation): kaolinite-cemented carbonaceous and silty fine-grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: Intact grain contacts between ductile and non-ductile grains show moderate rather than

extreme mechanical compaction. Oversized and elongate intergranular pores and molds of secondary origin added perhaps 10-15% porosity to the primary porosity. Intragranular porosity (leached alkali feldspar, muscovite lamellae, chert and phylloid clasts accounts for a further 5% as microporosity. Rhomb-shaped molds at grain margins in phylloid, polycrystalline quartz and chert grains provide ample evidence for the presence of a former carbonate cement. Decementation (of the carbonate cement) may also have removed a large amount of original mud matrix, thereby increasing permeability as well. Kaolinite and framboidal pyrite line the secondary pores, indicating relatively late diagenetic formation. The pyrite even occurs in leached intragranular pores. Other diagenetic processes include the partial alteration of muscovite to chlorite or siderite.

The thin section is of good quality, with only minor surface relief (a few micrometres) and a good polish. In the stained thin section, however, there are a few areas where the fluorescent lime green stain was not properly removed and grain plucking was high along a few of the muddy laminae (now anomalously green). It should also be noted that the colour of the epoxy in the unstained thin section varies from pink to blue, possibly due to overheating during curing.

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: Iss2061-N5
WELL NAME/DEPTH: Esso Gulf et al. Issungnak
2-O-61-70-10-134-00/2393.10 m

INDURATION: very poor either dry or immersed in water
COLOUR: medium brown with dark grey to black grains
SEDIMENTARY STRUCTURES: planar laminae are defined by carbonaceous films.

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 68

%gravel size: 0

%sand size: 56

%silt size: 10

%clay size: 2

Cement %: 1% pore-lining kaolinite, 1% quartz overgrowths.

Porosity %: 30% (a porosity of 31.7% and a permeability of 1620 millidarcies was determined for core plug 50, taken near the sample.

Modal Size: 0.15 mm.

Sorting: 16%/84% diameter ratio=
250 micrometres/ 100 micrometres = 2.5

Verbal Sorting Scale: moderately sorted.

GRAIN SIZE NAME: silty fine sandstone.

COMPOSITION: 15% monocrystalline grains, 5% polycrystalline quartz grains, 10% clear chert, 25% phylloid and siltstone clasts, 3% alkali feldspar, 2% muscovite flakes (partly altered to chlorite), 2% carbonaceous films, flakes and grains, trace plagioclase.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): Kaolinite and quartz cemented carbonaceous silty fine-grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: The nature of intact grain boundaries, especially between ductile and competent grains suggests that primary porosity was reduced to perhaps 20% prior to the occlusion of porosity by carbonate cement. All the criteria for secondary porosity are present, with rhomb-shaped carbonate dissolution molds suggesting once abundant carbonate cement. Of the 30% total porosity, about 25% is between grains

(mainly as elongate and oversized pores and to a lesser extent molds) and about 5% occurs as microporosity within grains (mainly the phylloid and chert clasts). Carbonate decementation, mainly of the carbonate-replaced outer parts of grains was undoubtedly responsible for the anomalously high porosity. The same process probably removed carbonate-replaced mud-sized matrix, which could explain in part the high permeability. The kaolinite and quartz cements line the secondary pores and were therefore relatively late in the diagenetic sequence.

The fluorescent lime green staining solution was not properly removed from parts of the stained section and in addition, too much of the epoxy impregnant was removed during staining. This excessive removal was a consequence of adding some of the lime green concentrate to the epoxy. It contains toluene which makes the epoxy soluble. The unstained thin section is, however of excellent quality.

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: Iss2061-N6
WELL NAME/DEPTH: Esso Gulf et al. Issungnak
2-O-61-70-10-134-00/2408.92 m

INDURATION: moderate either when dry or immersed in water.
COLOUR: light brown with dark grey grains.
SEDIMENTARY STRUCTURES: vague planar lamination.

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 65

%gravel size: 0

%sand size: 37

%silt size: 25

%clay size: 3?

Cement %: 2% pore-lining Kaolinite, 2% sparry carbonate cement, 1% quartz overgrowths.

Porosity %: 30% (a porosity of 24.9% and a permeability of 71.7 millidarcies was obtained for core plug 86, taken near the sample.

Modal Size: 0.090 mm.

Sorting: 16%/84% diameter ratio=
200 micrometres/ 40 micrometres = 5

Verbal Sorting Scale: poorly sorted

GRAIN SIZE NAME: silty very fine sandstone.

COMPOSITION: 12% monocrystalline quartz grains, 5% polycrystalline quartz grains, 13% clear chert, 2% alkali feldspar, 18% phylloid and siltstone clasts, 3% muscovite flakes 1% chlorite grains, 3% sparry carbonate grains (remnant replacements), tr heavy minerals, microcline, plagioclase, volcanic rock fragments, clasts of microspar-sized carbonate, tr pyrite partly replacing chert grains. Unidentified silt and clay sized material comprises the remainder.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): carbonate/Kaolinite-cemented carbonaceous silty very fine litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: The most important diagenetic event was the extensive production of secondary porosity, mainly as oversized and elongate pores. The nature of unaffected grain contacts suggests that primary porosity was

reduced to about 15 or 20% (dependent on original mud matrix content) prior to carbonate cementation. A minor amount of spar sized carbonate cement remains. Of the total porosity, about 5% occurs as microporosity within grains (especially the chert and phylloid clasts). Other diagenetic processes include the alteration of muscovite to chlorite and/or microspar-sized carbonate. Pore-lining kaolinite lines pores of secondary origin and is therefore late diagenetic. The moderate induration is probably related to the carbonate cement content.

Fluorescent lime green concentrate was added to the epoxy to increase the solubility of dyes and lower viscosity (the dye is dissolved in toluene). This increased the solubility of the epoxy impregnant such that much of it has been dissolved during staining with the lime green concentrate solution. The unstained section, however, is of good quality with a relief of about 2-4 micrometres between hard quartz-rich grains and soft clay-rich grains.

THIN SECTION MODAL AND GRAIN SIZE ANALYSIS

Sample I.D.: Iss2061-N6

	No of Points	Percentage of Components	Percentages of Detrital Components
Detrital Components			
Monocrystalline Quartz	95	31.67	40.60
Polycrystalline Quartz	16	5.33	6.84
Clear Chert	36	12.00	15.38
Black Chert	10	3.33	4.27
Alkali Feldspar	25	8.33	10.68
Plagioclase	0	0.00	0.00
Phylloid Clasts	37	12.33	15.81
Volcanic Clasts	0	0.00	0.00
Chlorite	1	0.33	0.43
Mica	2	0.67	0.85
Siltstone Clasts	3	1.00	1.28
Coal	0	0.00	0.00
Unidentified (too small)	7	2.33	2.99
Other Clasts	2	0.67	0.85
Cements			
Kaolinite	0	0.00	
Carbonate	0	0.00	
Other	0	0.00	
Porosity			
Intergranular/ Moldic	64	21.33	

Intragranular	2	0.67

Plucked Grains=14

Total number of points counted minus plucked grains= 300

GRAIN SIZE ANALYSIS

Sample I.D.: Iss2061-N6

Class Interval (phi)	No. Freq of Max Apparent Grain Dimen-sion	Percentage Frequency	Cumulative Percentage Frequency
2.0 to 1.5	2	1.0	1.0
2.5 to 2.0	10	5.0	6.0
3.0 to 2.5	48	24.0	30.0
3.5 to 3.0	59	29.5	59.5
4.0 to 3.5	60	30.0	89.5
4.5 to 4.0	12	6.0	95.5
5.0 to 4.5	3	1.5	97.0
5.5 to 5.0	2	1.0	98.0
6.0 to 5.5	2	1.0	99.0
6.5 to 6.0	0	0.0	99.0
7.0 to 6.5	1	0.5	99.5
7.5 to 7.0	1	0.5	100.0

GRAPHIC GRAIN SIZE CUMULATIVE PERCENTILES IN PHI (MICROMETRE) UNITS OF SELECTED DETRITAL COMPONENTS

Sample I.D.: Iss2061-N6

Percentiles	Phi Values	Micrometres
1	2.00	250
5	2.45	183
16	2.78	146

25	2.93	131
50	3.34	99 (very fine sand size)
75	3.71	76
84	3.87	68
95	4.45	46

$$\text{Graphic Sorting (Inman)} = \frac{\text{Phi(84)} - \text{Phi(16)}}{2} = 0.55$$

Verbal Sorting Scale= moderately sorted

Total Number of Grains Measured= 200

Note: Thin section grain size analysis indicates moderate rather than poor sorting that was estimated qualitatively. Modal analysis did not detect cements but indicated much more monocrystalline and alkali feldspar grains than was subjectively estimated. On the other and, intragranular porosity is probably underestimated by modal analysis.

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: Iss2061-N7
WELL NAME/DEPTH: Esso Gulf et al. Issungnak 2-O-61-70-10-134-00/2414.75 m

INDURATION: very poor when dry, disaggregates by itself moments after immersion in water.
COLOUR: medium brown
SEDIMENTARY STRUCTURES: vague planar laminae, extensively bioturbated (0.4 mm diameter tubes), fractures probably formed by drying of the core.

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 88

%gravel size: 0

%sand size: 5

%silt size: 58

%clay size: 25

Cement %: 2% scattered sparry carbonate

Porosity %: 10% (a porosity of 17.5% and a permeability of 0.07 millidarcies was obtained for plug 103, taken near the sample).

Modal Size: 0.015 mm.

Sorting: 16%/84% diameter ratio=
50 micrometres/ 2? micrometres = 25?

Verbal Sorting Scale: very poorly sorted.

GRAIN SIZE NAME: medium siltstone.

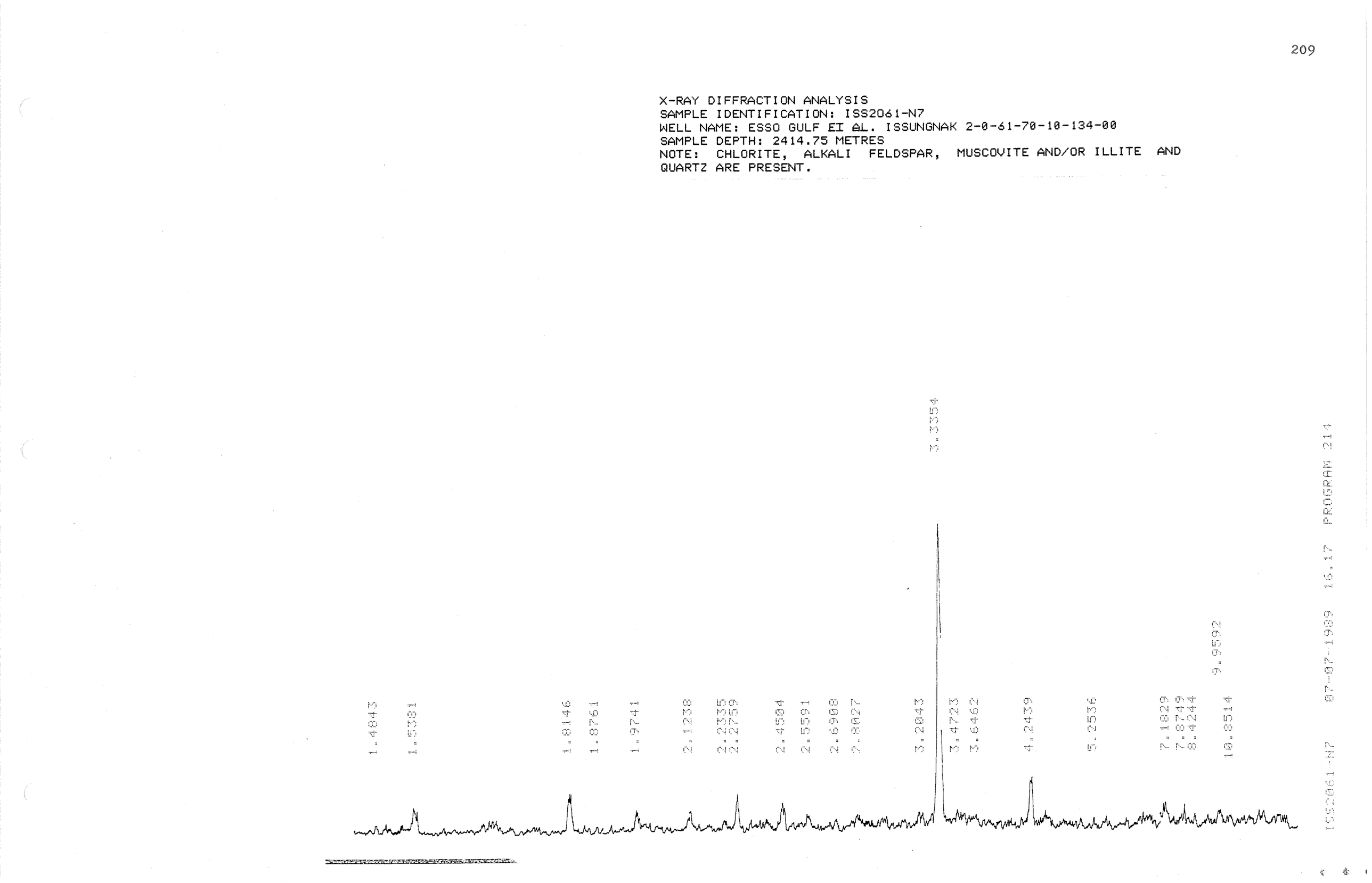
COMPOSITION: 20% monocrystalline quartz, tr polycrystalline quartz, 2% chert grains, 15% muscovite flakes (in part altered to chlorite), 20% phylloid clasts, 5% scattered carbonaceous flakes and grains, trace translucent reddish-brown resin(?), 1% alkali feldspar, 3% clasts of microspar-sized siderite?, tr glauconite pellets?. The remainder is unidentifiable clay and silt-sized material.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): carbonaceous litharenitic medium siltstone.

PETROGENESIS/ADDITIONAL INFORMATION: A moderate amount of bioturbation is evidenced by clay and silt-rich tubes. The fine grain size precludes detailed optical analysis. Mechanical compaction, however, was of major importance in reducing primary porosity.

The thin sections are of poor quality and required surface impregnation with cyanoacrylate at a thickness of 0.1 mm to reduce further grain plucking.

X-RAY DIFFRACTION ANALYSIS
SAMPLE IDENTIFICATION: ISS2061-N7
WELL NAME: ESSO GULF ET AL. ISSUNGNAK 2-0-61-70-10-134-00
SAMPLE DEPTH: 2414.75 METRES
NOTE: CHLORITE, ALKALI FELDSPAR, MUSCOVITE AND/OR ILLITE AND QUARTZ ARE PRESENT.



HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: Iss2061-N8
WELL NAME/DEPTH: Esso Gulf et al. Issungnak
2-0-61-70-10-134-00/2494.00 m.

INDURATION: very poor, either dry or immersed in water.
COLOUR: light brown.
SEDIMENTARY STRUCTURES: vague laminae are defined by slight grain size variations.

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 66

%gravel size: 0

%sand size: 49

%silt size: 15

%clay size: 2?

Cement %: 2% pore-lining kaolinite, 1% quartz overgrowths, 1% pore-lining framboidal pyrite, tr sparry carbonate.

Porosity %: 30% (a porosity of 30.5% and a permeability of 375 millidarcies was obtained for core 114, taken near the sample).

Modal Size: 0.12 mm.

Sorting: 16%/84% diameter ratio=
250 micrometres/ 70 micrometres = 3.6

Verbal Sorting Scale: moderately sorted

GRAIN SIZE NAME: silty very fine sandstone.

COMPOSITION: 20% monocrystalline quartz grains, 5% polycrystalline quartz grains, 15% clear chert, 1% alkali feldspar, 15% phylloid and siltstone clasts, 3% muscovite flakes, 3% chlorite flakes, tr glauconite and possibly altered glauconite, tr coal, tr plagioclase.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): Kaolinite/quartz/pyrite cemented glauconite-bearing silty very fine grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: Secondary porosity is well developed except in the muddy laminae. In general, 25% porosity occurs between grains while 5% is present within grains (mainly the chert and phylloid clasts). Primary porosity (judging from the degree of mechanical and chemical compaction was probably reduced to about 15%. A doubling of porosity may therefore be attributed to secondary porosity development. Most of it occurs

as oversized pores and elongate grains though grain molds are also present. The framework grains are corroded though rhomb-shaped molds are absent. Traces of sparry carbonate cement, however, suggest that it may have been common previously. By analogy with nearby samples carbonate decementation probably was the process by which the secondary porosity was formed. The compacted silty laminae show no evidence of secondary porosity, which suggests a threshold permeabilty is required for its development. Pyrite framboids and kaolinite line secondary pores and are therefore relatively late diagenetic.

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: Iss2061-N9
WELL NAME/DEPTH: Esso Gulf et al. Issungnak 2-0-61-70-10-134-00/2497.34 m.

INDURATION: poor either dry or immersed in water.
COLOUR: light brown with dark grey grains.
SEDIMENTARY STRUCTURES: massive.

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 61

%gravel size: 0

%sand size: 48

%silt size: 10

%clay size: 3?

Cement %: 2% kaolinite, 1% quartz overgrowths, 1% framboidal pyrite.

Porosity %: 35% (a porosity of 29.5% and a permeability of 990 millidarcies was determined for core plug 124, taken near the sample).

Modal Size: 0.20 mm.

Sorting: 16%/84% diameter ratio=
350 micrometres/ 65 micrometres = 5.4

Verbal Sorting Scale: poorly sorted

GRAIN SIZE NAME: silty fine sandstone.

COMPOSITION: 10% monocrystalline quartz, 5% polycrystalline quartz, 15% clear chert, 15% phylloid clasts (including quartz-muscovite schist, chlorite-rich grains and shales or mudstones) and siltstone grains, 5% alkali feldspar grains, 2% muscovite flakes, tr unaltered glauconite pellets. Unidentified silt and clay sized material comprises the remainder.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): Kaolinite/quartz/pyrite cemented glauconite-bearing silty fine-grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: Primary porosity was reduced during burial to about 15 or 20%, judging by the nature of the intact grain boundaries. Secondary porosity (mainly as oversized and elongate pores between grains) but also as molds is responsible for enhancing porosity to its present value of 35%. All the criteria for recognizing secondary porosity are present

and need not be listed. Visual estimates divide total porosity as 30% between grains and 5% withing grains. The latter occurs as microporosity in phylloid, siltstone, polycrystalline quartz, chert, muscovite, chloritic grains and honeycombed alkali feldspar grains. Though not abundant, rhomb-shaped molds point to a former carbonate cement filling pores but also partly replacing grains. Decementation was undoubtedly the mechanism of porosity enhancement. Finally, pyrite framboids and kaolinite were precipitated in these intergranular pores. The framboidal pyrite has also been observed in intragranular pores.

THIN SECTION MODAL AND GRAIN SIZE ANALYSIS

Sample I.D.: Iss2061-N9

	No of Points	Percentage of Components	Percentages of Detrital Components
Detrital Components			
Monocrystalline Quartz	78	26.0	32.64
Polycrystalline Quartz	26	8.67	10.88
Clear Chert	64	21.33	26.78
Black Chert	12	4.00	5.02
Alkali Feldspar	12	4.00	5.02
Plagioclase	0	0.00	0.00
Phylloid Clasts	24	8.00	10.04
Volcanic Clasts	1	0.33	0.42
Chlorite	2	0.67	0.84
Mica	1	0.33	0.42
Siltstone Clasts	9	3.00	3.77
Coal	0	0.00	0.00
Unidentified (too small)	8	2.67	3.35
Other Clasts	2	0.67	0.84
Cements			
Kaolinite	0	0.00	
Carbonate	0	0.00	
Other	0	0.00	
Porosity			
Intergranular/ Moldic	61	20.33	

Intragranular	0	0.00

Plucked Grains: 1

Total number of points counted minus plucked grains= 300

GRAIN SIZE ANALYSIS

Sample I.D.: Iss2061-N9

Class Interval (phi)	No. Freq of Max Apparent Grain Dimen-sion	Percentage Frequency	Cumulative Percentage Frequency
1.0 to 0.5	2	1.0	1.0
1.5 to 1.0	17	8.5	9.5
2.0 to 1.5	77	38.5	48.0
2.5 to 2.0	60	30.0	78.0
3.0 to 2.5	15	7.5	85.5
3.5 to 3.0	8	4.0	89.5
4.0 to 3.5	8	4.0	93.5
4.5 to 4.0	2	1.0	94.5
5.0 to 4.5	3	1.5	96.0
5.5 to 5.0	2	1.0	97.0
6.0 to 5.5	1	0.5	97.5
6.5 to 6.0	1	0.5	98.0
7.0 to 6.5	2	1.0	99.0
7.5 to 7.0	0	0.0	99.0
8.0 to 7.5	0	0.0	99.0

GRAPHIC GRAIN SIZE CUMULATIVE PERCENTILES IN PHI (MICROMETRE) UNITS OF SELECTED DETRITAL COMPONENTS

Sample I.D.: Iss2061-N9

Percentiles Phi Values Micrometres

1	1.00	500	
5	1.33	398	
16	1.63	323	
25	1.76	295	
50	2.03	245	(fine sand size)
75	2.45	183	
84	2.89	135	
95	4.65	40	

$$\text{Graphic Sorting (Inman)} = \frac{\text{Phi(84)} - \text{Phi(16)}}{2} = 0.63$$

Verbal Sorting Scale= moderately sorted

Total Number of Grains Measured= 200

Note: More silt was estimated from a sample fracture surface than was determined in thin section grain size analysis, a difference which explains the different sorting values. Thin section modal analysis indicated more monocrystalline quartz grains (26 rather than 10%) and fewer phylloid grains (8 rather than 15%) than were estimated qualitatively. The cements, however which are easily seen in a sample fracture surface were not detected in the thin section modal analysis. In addition, porosity seems to be underestimated by modal analysis.

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: Iss2061-N10
WELL NAME/DEPTH: Esso Gulf et al. Issungnak
2-O-61-70-10-134-00/3146.24 m

INDURATION: moderate either dry or immersed in water. This moderate induration is probably due to the more extreme degree of mechanical compaction.
COLOUR: light brown with dark grey grains.
SEDIMENTARY STRUCTURES: massive

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 69

%gravel size: 0

%sand size: 55

%silt size: 10

%clay size: 4?

Cement %: 4% pore-lining kaolinite, 1% quartz overgrowths, 1% pyrite framboids.

Porosity %: 25 (a porosity of 24.4% and a permeability of 464 millidarcies was obtained for core plug 173, taken near the sample).

Modal Size: 0.15 mm.

Sorting: 16%/84% diameter ratio=
250 micrometres/ 70 micrometres = 3.5

Verbal Sorting Scale: moderately sorted.

GRAIN SIZE NAME: silty fine sandstone.

COMPOSITION: 15% monocrystalline quartz, 5% polycrystalline quartz, 15% chert, 15% phylloid and siltstone clasts, 3% alkali feldspar grains, 2% muscovite, tr microcline, tr volcanic rock fragments, tr chlorite, tr plagioclase, tr unaltered glauconite pellets, tr coal grains. Unidentifiable silt and clay-sized material comprises the remainder.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): Kaolinite/quartz/pyrite cemented glauconite-bearing silty fine grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: Secondary porosity development is the most important diagenetic process. In the sample about 5% is moldic porosity, about 5% is within grains and 15% is between grains as oversized and elongate pores. Rhomb-

shaped carbonate dissolution molds are common at grain boundaries and within grains. Framboidal pyrite and kaolinite line secondary pores and are therefore relatively late diagenetic. Reduction of secondary porosity is evidenced by ductile grains that have been squeezed into the corroded grain boundaries (including partial rhomb-shaped carbonate dissolution molds). This could be explained by the greater burial depth. The alteration of muscovite (as flakes and in phylloid clasts) to chlorite and clays was a major diagenetic event, but one which did not appreciably affect porosity. Mechanical compaction, as evidenced by squeezed ductile grains has been more extreme than observed from shallower samples in this well.

The stained polished thin section is of inferior quality because too much of the epoxy was dissolved (the addition of toluene makes the epoxy soluble) and some of the fluorescent lime green stain was not properly removed from the surface.

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: Iss2061-N11
WELL NAME/DEPTH: Esso Gulf et al. Issungnak
2-O-61-70-10-134-00/3147.33 m

INDURATION: moderate either dry or immersed in water.
COLOUR: light brown with carbonaceous films.
SEDIMENTARY STRUCTURES: planar laminae are defined by concentrations of carbonaceous material.

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 75%

%gravel size: 0

%sand size: 61

%silt size: 10

%clay size: 4?

Cement %: 3% kaolinite, 1% quartz overgrowths, 1% pyrite framboids.

Porosity %: 25% (a porosity of 21.6% and a permeability of 57.5 millidarcies was determined for core plug 177, taken near the sample).

Modal Size: 0.15 mm.

Sorting: 16%/84% diameter ratio=
250 micrometres/ 80 micrometres = 3.1

Verbal Sorting Scale: moderately sorted.

GRAIN SIZE NAME: silty fine sandstone.

COMPOSITION: 20% monocrystalline quartz, 5% polycrystalline quartz, 15% chert, 20% phylloid and siltstone clasts, 2% alkali feldspar, 4% carbonaceous films, 2% muscovite flakes (in part altered to carbonate, chlorite and clays), tr microcline, tr plagioclase, tr unaltered glauconite pellets, tr chlorite flakes.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): kaolinite/quartz/pyrite cemented carbonaceous and glauconite-bearing silty fine grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: The porosity (25%) is approximately divided as follows: 5% is moldic, 15% occurs in elongate and oversized pores between grains and 5% is microporosity within phylloid and chert clasts with traces in leached alkali feldspar and muscovite flakes. Carbonate cement is all but absent but the abundance of rhomb-shaped corrosion molds

(both as partial molds at grain boundaries and complete molds within grains) suggests that the dissolution of carbonate (and carbonate replaced grains and matrix) greatly increased porosity. Another important diagenetic event was the alteration of muscovite (as flakes and within quartz-muscovite schist grains) to chlorite, carbonate and clays. Framboidal pyrite and kaolinite line secondary pores, suggesting that their formation was relatively late diagenetic. A significant amount of compaction ocurred after secondary porosity development, as illustrated by phylloid clasts that have been squeezed into the carbonate dissolution molds (including rhomb-shaped ones) of adjacent competent grains. This compaction, which may be a result of the greater depth of burial, explains the comparatively low permeability of 57.5 millidarcies.

Problems encountered included overheating of the epoxy during curing, resulting in discolouration of the dye in places to a pink colour. The pink-coloured epoxy was not susceptible to staining with the fluorescent lime-green concentrate. Otherwise the quality of the sections is excellent, with minimal (2-4 micrometres) of surface relief between hard and soft grains).

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: Iss2061-n12
WELL NAME/DEPTH: Esso Gulf et al. Issungnak 2-0-61-70-10-134-00/3151.96 m

INDURATION: poor either wet or immersed in water.
COLOUR: light brown with dark grey grains.
SEDIMENTARY STRUCTURES: planar laminae are defined by concentrations of carbonaceous material.

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 75

%gravel size: 0

%sand size: 49

%silt size: 10

%clay size: 9?

Cement %: 5% kaolinite, 1% quartz overgrowths, 1% sparry carbonate cement.

Porosity %: 20 (a porosity of 10% and a permeability of 0.43 millidarcies was measured for core plug 190 taken near the sample). The measured porosity is much less than is visible and probably represents a different lithology.

Modal Size: 0.12 mm.

Sorting: 16%/84% diameter ratio=
200 micrometres/ 40 micrometres = 5

Verbal Sorting Scale: poorly sorted.

GRAIN SIZE NAME: muddy very fine sandstone.

COMPOSITION: 15% monocrystalline quartz, 3% polycrystalline quartz, 10% clear chert, 20% phylloid clasts, 3% alkali feldspar, 2% clasts of microspar-sized carbonate, 3% muscovite flakes, tr plagioclase, chlorite flakes and pyrite framboids. Unidentifiable material, mainly in the silt and clay size range, comprises the remainder.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): Kaolinite and quartz cemented muddy very fine grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: Oversized and elongate intergranular pores, corroded grains, as well as moldic and leached intragranular pores point to secondary porosity development. Moldic porosity accounts for about 3%, intragranular

porosity is about 5%, and intergranular porosity is about 12%. The microporosity in the clay-rich phylloid grains is difficult to estimate and may be higher than this value). Ductile grains (mainly phylloid clasts) have been squeezed into the corrosion molds (some of which are convincingly rhomb-shaped), of competent grains, which suggests a major compaction event after the development of secondary porosity. The permeability of this sample must be very low. The high degree of mainly mechanical compaction could be relted to the depth of burial.

Excessive grain plucking (because of high clay content) required surface impregnation with cyanoacrylate when the section was 0.1 mm thick. Despite this, the surface relief between grains remains high. It should also be noted that the fluorescent lime green stain has stained clays as well as epoxy. SEM study would be beneficial in determining the porosity distribution between and within grains for this sample.

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: Iss2061-N13
WELL NAME/DEPTH: Esso Gulf et al. Issungnak
2-O-61-70-10-134-00/3198.00 m

INDURATION: moderate, either dry or immersed in water (does not disaggregate by itself).
COLOUR: medium grey with dark grey grains.
SEDIMENTARY STRUCTURES: poorly defined bedding plane parting.

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 71

%gravel size: 0

%sand size: 66

%silt size: 3

%clay size: 2?

Cement %: 2% kaolinite cement, 2% quartz overgrowths, trace pyrite framboids.

Porosity %: 25 (a porosity of 25.3% and a permeability of 518 millidarcies was measured for core plug 192, taken near the sample).

Modal Size: 0.2 mm.

Sorting: 16%/84% diameter ratio=
250 micrometres/ 100 micrometres = 2.5

Verbal Sorting Scale: moderately sorted.

GRAIN SIZE NAME: fine sandstone.

COMPOSITION: 20% monocrystalline quartz grains, 3% polycrystalline quartz grains, 25% chert clasts, 3% alkali feldspar grains, 15% phylloid clasts, 2% coal grains, trace chlorite, trace plagioclase, trace high relief, high birefringent minerals, trace light green translucent heavy minerals (apatite?), trace zircon.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): kaolinite/quartz-cemented coal-bearing fine-grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: There is a relatively high proportion of heavy minerals in this sample, though the depositional significance of this is not clear. The porosity distribution is approximately as follows; 5% is moldic, 3% (at least) is secondary intragranular and 17% is intergranular. The

secondary intragranular porosity occurs as leached alkali feldspar, phylloid, chert and mica grains. Mechanical compaction was an important porosity reducing process, as evidenced by ductile grains squeezed between more competent grains. Pressure solution was moderately important in reducing porosity as shown by both planar and concavo-convex contacts between quartzose grains. Rhomb-shaped spar-sized carbonate molds at grain boundaries suggests the former presence of carbonate cement.

The moderate degree of induration both dry and wet is without doubt a consequence of quartz cementation.

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: Iss2061-N14
WELL NAME/DEPTH: Esso Gulf et al. Issungnak
2-O-61-70-10-134-00/3198.85 m

INDURATION: moderate either dry or immersed in water.
COLOUR: light brown with dark grey grains.
SEDIMENTARY STRUCTURES: massive.

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 67

%gravel size: 0

%sand size: 54

%silt size: 10

%clay size: 3?

Cement %: 2% pore-lining Kaolinite, 1% quartz overgrowths.

Porosity %: 30% (a porosity of 24.0% and a permeability of 432 millidarcies was measured for core plug 195, taken near the sample).

Modal Size: 0.15 mm.

Sorting: 16%/84% diameter ratio=
250 micrometres/ 100 micrometres = 2.5

Verbal Sorting Scale: moderately sorted.

GRAIN SIZE NAME: silty fine sandstone.

COMPOSITION: 20% monocrystalline quartz, 5% polycrystalline quartz, 20% chert, 15% phylloid and siltstone clasts, 3% alkali feldspar grains, tr microcline, plagioclase, tr chlorite flakes, tr altered glauconite(?) pellets, tr coal grains, tr carbonate.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): Kaolinite and quartz cemented silty fine grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: Secondary porosity development, mainly as elongate and oversized pores was the most significant diagenetic event. The porosity is distributed approximately as follows; 5% within grains, 3% as molds and 22% between grains. The intragranular porosity is best developed in the phylloid and chert grains. The other criteria for recognizing secondary porosity such as honeycombed and floating grains are all present but are not important volumetrically. The nature of grain boundaries that were unaffected by secondary porosity

development suggests that primary porosity was reduced to about 15% (dependent on original clay content) prior to carbonate cementation and replacement. Decementation of the carbonate probably doubled the primary porosity (after initial compaction) and also increased permeability by eliminating carbonate-replaced mud matrix (if present) and by increasing the size of the pore throats. The evidence for the presence of a former carbonate cement includes good examples of rhomb-shaped molds at grain boundaries as well as within grains. Another widespread diagenetic process, though not directly effecting porosity, was the alteration of muscovite (both as flakes and in quartz-muscovite schist) to chlorite, carbonate or clays. Few of the ductile grains have been squeezed into the grain-bounding corrosion molds and elongate pores, suggesting little compaction after decementation. Pressure solution was also of relatively minor importance. In part, the lack of compaction could be explained by the lower proportion of ductile grains. Finally, kaolinite and quartz cements line secondary pores and are therefore relatively late in the diagenetic sequence.

The thin sections have a good polish with almost no surface relief between hard and soft grains. Minor relief of a few micrometres, however, occurs at the interface between the grains and the epoxy.

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: Iss2061-N15
WELL NAME/DEPTH: Esso Gulf et al. Issungnak 2-O-61-70-10-134-00/3199.45 m

INDURATION: moderate either dry or immersed in water.
COLOUR: light brown with dark grey grains.
SEDIMENTARY STRUCTURES: massive.

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 73

%gravel size: 0

%sand size: 65

%silt size: 5

%clay size: 3?

Cement %: 1% kaolinite, 1% quartz overgrowths.

Porosity %: 25 (a porosity of 25.6% and a permeability of 394 millidarcies was measured for core plug 197, taken near the sample).

Modal Size: 0.15 mm.

Sorting: 16%/84% diameter ratio=
200 micrometres/ 90 micrometres = 2.2

Verbal Sorting Scale: moderately sorted.

GRAIN SIZE NAME: muddy fine sandstone.

COMPOSITION: 25% monocrystalline quartz grains, 5% polycrystalline quartz grains, 15% chert grains, 15% phylloid and siltstone clasts, 3% muscovite flakes (in part altered to carbonate), 1% clasts composed of carbonate, 1% coal grains, trace plagioclase, trace translucent heavy minerals, trace chlorite flakes, trace altered pellets of glauconite(?), trace volcanic fragments.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): Kaolinitic- and quartz-cemented fine grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: The development of secondary porosity was the most important diagenetic event. The porosity distribution is now approximately as follows; 5% is moldic, 5% is intragranular and 15% is intergranular. The estimate for moldic porosity represents a minimum because it is unknown how much silt and clay sized material was removed during carbonate

decementation. The intragranular porosity occurs mainly in phylloid and chert clasts where rhomb-shaped molds hint at the former presence of carbonate replacement. The intergranular porosity between grains was increased during secondary porosity development as evidenced by oversized and elongate pores and corroded grain boundaries with partial rhomb molds. Carbonate decementation is believed to be the mechanism of this porosity enhancement. The degree of compaction (mechanical and chemical) for grains unaffected by secondary porosity development is moderate, suggesting that carbonate cement was introduced at relatively shallow depths. The kaolinite and quartz cements line secondary pores and are therefore relatively late diagenetic. Compaction after secondary porosity development was minor, as illustrated by a few ductile grains that have been squeezed into the rhombic carbonate dissolution molds of adjacent competent grains. Another common diagenetic process was the alteration of muscovite (both as flakes and in quartz-muscovite schist grains) to chlorite.

The thin section is of good quality with only minor surface relief and a good podish.

THIN SECTION MODAL AND GRAIN SIZE ANALYSIS

Sample I.D.: Iss2061-N15

	No of Points	Percentage of Components	Percentages of Detrital Components
Detrital Components			
Monocrystalline Quartz	105	35.00	46.05
Polycrystalline Quartz	17	5.67	7.46
Clear Chert	47	15.67	20.61
Black Chert	7	2.33	3.07
Alkali Feldspar	17	5.67	7.46
Plagioclase	0	0.00	0.00
Phylloid Clasts	25	8.33	10.96
Volcanic Clasts	0	0.00	0.00
Chlorite	1	0.33	0.44
Mica	4	1.33	1.75
Siltstone Clasts	1	0.33	0.44
Coal	0	0.00	0.00
Unidentified (too small)	1	0.33	0.44
Other Clasts	3	1.00	1.32
Cements			
Kaolinite	2	0.67	
Carbonate	1	0.33	
Other	2	0.67	
Porosity			
Intergranular/ Moldic	66	22.00	